

The Mass of Asteroid 253 Mathilde from NEAR Tracking Data

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The first asteroid mass determination using spacecraft tracking data will be made as a result of the NEAR spacecraft flying past asteroid 253 Mathilde on June 27, 1997. The NEAR spacecraft is scheduled to pass within 1200 km of Mathilde at a relative velocity of 10 km/s. Doppler X-band tracking data will be analyzed to determine the gravitational perturbation upon the spacecraft due to Mathilde's mass. The spacecraft will be continuously tracked on either side of the encounter - except for a period of about one hour at closest approach when imaging experiments will be conducted. An error analysis by one of us (DJS) studied the sensitivity of the mass determination accuracy to the amount of continuous tracking time available before and after the encounter. The asteroid's diameter and bulk density were assumed to be 61 km and 2.6 g/cc respectively. Taking into account the uncertainties in the tracking station locations, the spacecraft's orientation, the Earth's timing and tropospheric/ionospheric effects, it appears likely that Mathilde's mass can be determined to the 10% level if the spacecraft is tracked continuously for three days on either side of the close approach. An analysis of Mathilde's shape, by the NEAR imaging team and the expected long-term radar imaging of the asteroid during the second half of 1997 by Steve Ostro and his colleagues should allow a volume (and hence a bulk density) determination to a comparable level of accuracy.